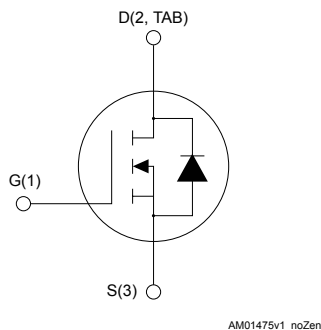
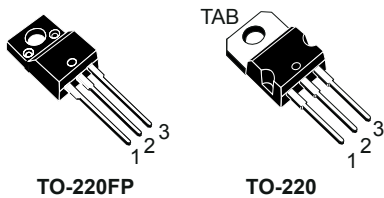


N-channel 500 V, 285 mΩ typ., 12 A MDmesh II Power MOSFETs in TO-220FP and TO-220 packages



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STF14NM50N	500 V	320 mΩ	12 A
STP14NM50N			

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the second generation of MDmesh technology. These revolutionary Power MOSFETs associate a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. They are therefore suitable for the most demanding high-efficiency converters.



Product status links

[STF14NM50N](#)

[STP14NM50N](#)

Product summary

Order code	STF14NM50N
Marking	14NM50N
Package	TO-220FP
Packing	Tube
Order code	STP14NM50N
Marking	14NM50N
Package	TO-220
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220FP	TO-220	
V_{DS}	Drain-source voltage	500		V
V_{GS}	Gate-source voltage	± 25		V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	12 ⁽¹⁾	12	A
	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	8 ⁽¹⁾	8	
I_{DM} ⁽²⁾	Drain current (pulsed)	48 ⁽¹⁾	48	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	25	90	W
dv/dt ⁽³⁾	Peak diode recovery voltage slope	15		V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1\text{ s}$, $T_C = 25\text{ }^{\circ}\text{C}$)	2.5		kV
T_{stg}	Storage temperature range	-55 to 150		$^{\circ}\text{C}$
T_J	Operation junction temperature range			$^{\circ}\text{C}$

1. Limited by maximum junction temperature.
2. Pulse width is limited by safe operating area.
3. $I_{SD} \leq 12\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS}(\text{peak}) \leq V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		TO-220FP	TO-220	
R_{thJC}	Thermal resistance, junction-to-case	5	1.39	$^{\circ}\text{C}/\text{W}$
R_{thJA}	Thermal resistance, junction-to-ambient	62.5		$^{\circ}\text{C}/\text{W}$

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or non-repetitive (pulse width limited by T_J max.)	4	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	172	mJ

2 Electrical characteristics

$T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 4. On/off states

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0\text{ V}$	500			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}^{(1)}$			100	
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 6\text{ A}$		285	320	m Ω

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	816	-	pF
C_{oss}	Output capacitance		-	60	-	pF
C_{rss}	Reverse transfer capacitance		-	3	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }400\text{ V}$, $V_{GS} = 0\text{ V}$	-	308	-	pF
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $I_D = 12\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see the Figure 15. Test circuit for gate charge behavior)	-	27	-	nC
Q_{gs}	Gate-source charge		-	5	-	nC
Q_{gd}	Gate-drain charge		-	15	-	nC
R_g	Gate input resistance	$f = 1\text{ MHz}$, open drain	-	4.5	-	Ω

1. $C_{oss\text{ eq.}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS} .

Table 6. Switching times

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$, $I_D = 12\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	12	-	ns
t_r	Rise time		-	16	-	ns
$t_{d(off)}$	Turn-off delay time	(see the Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform)	-	42	-	ns
t_f	Fall time		-	22	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		12	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		48	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 12\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$	-	252		ns
Q_{rr}	Reverse recovery charge		-	2.8		μC
I_{RRM}	Reverse recovery current	(see the Figure 16. Test circuit for inductive load switching and diode recovery times)	-	22		A
t_{rr}	Reverse recovery time	$I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$	-	300		ns
Q_{rr}	Reverse recovery charge		-	3.3		μC
I_{RRM}	Reverse recovery current	(see the Figure 16. Test circuit for inductive load switching and diode recovery times)	-	22.2		A

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area for TO-220

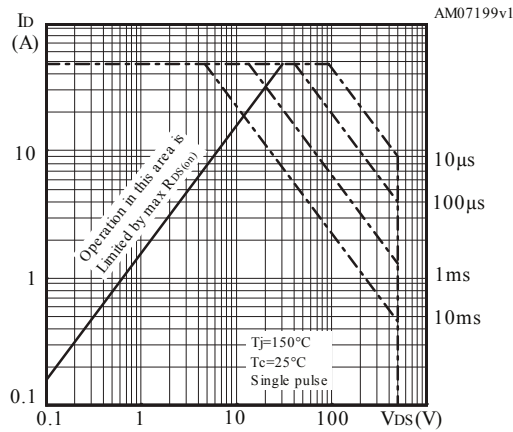


Figure 2. Normalized transient thermal impedance for TO-220

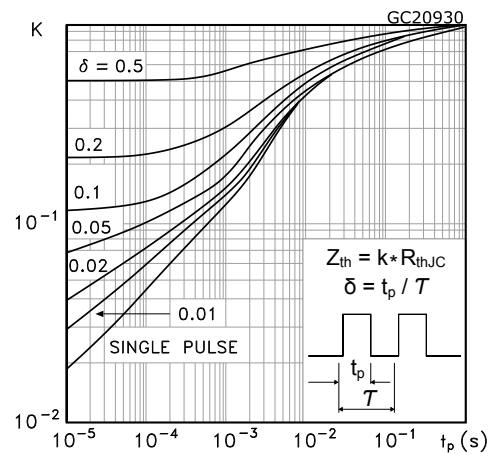


Figure 3. Safe operating area for TO-220FP

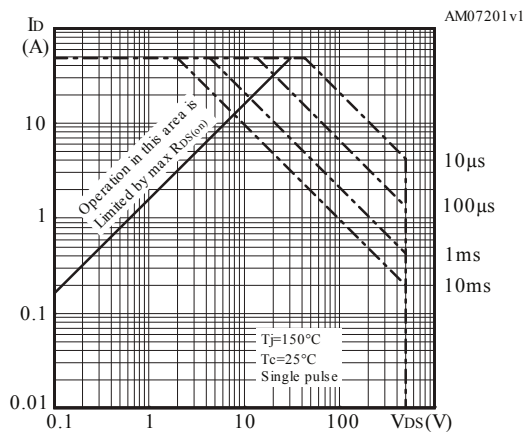


Figure 4. Normalized transient thermal impedance for TO-220FP

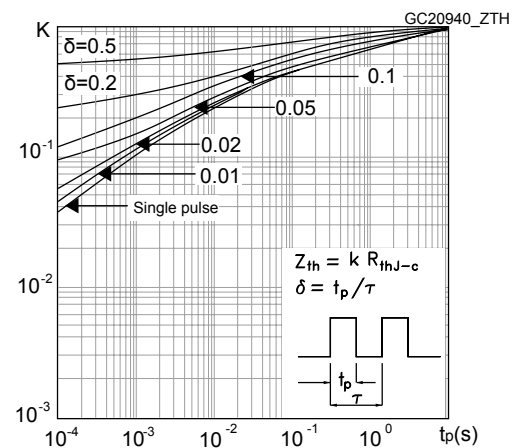


Figure 5. Typical output characteristics

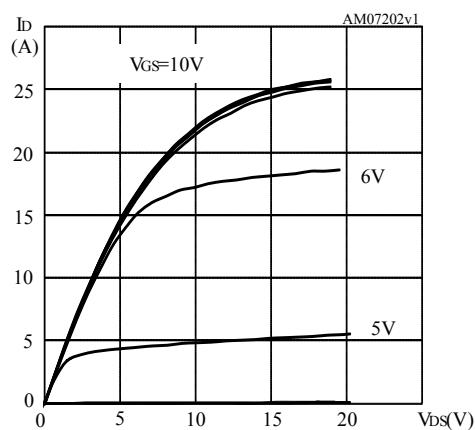


Figure 6. Typical transfer characteristics

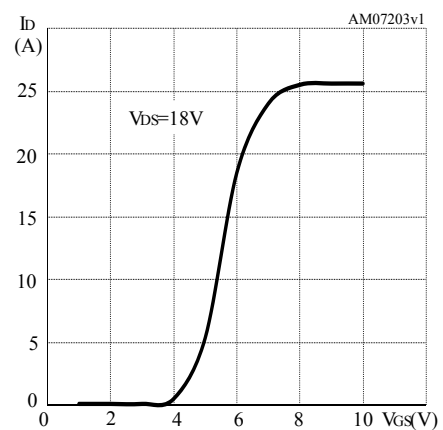


Figure 7. Typical gate charge characteristics

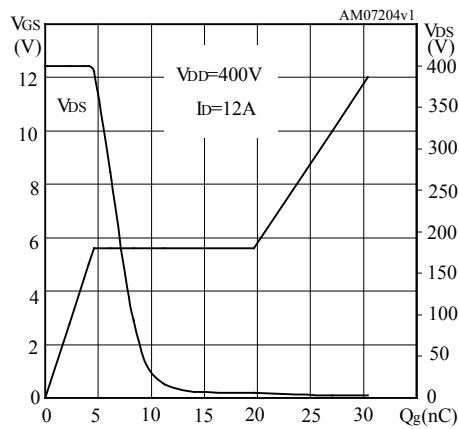


Figure 8. Typical drain-source on-resistance

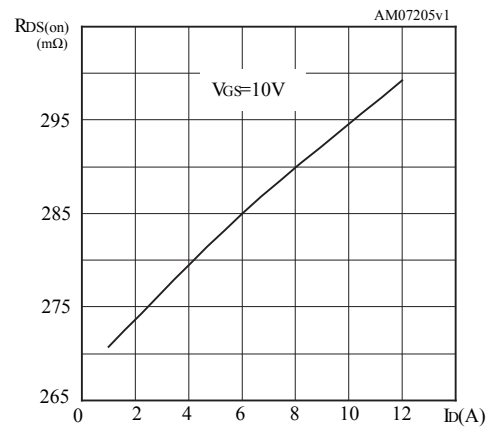


Figure 9. Typical capacitance characteristics

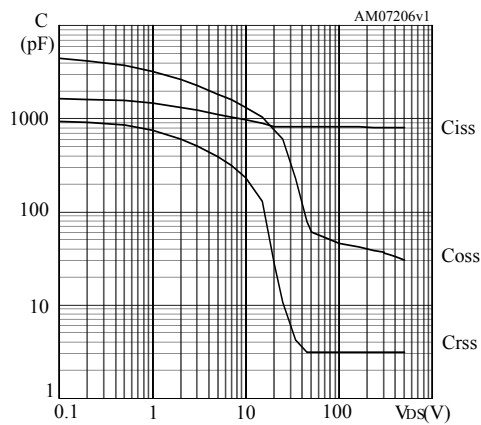


Figure 10. Normalized gate threshold vs temperature

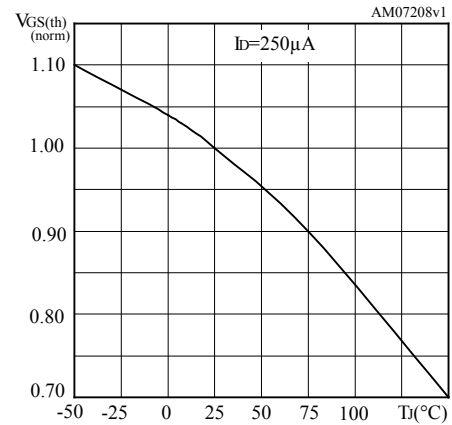


Figure 11. Normalized on-resistance vs temperature

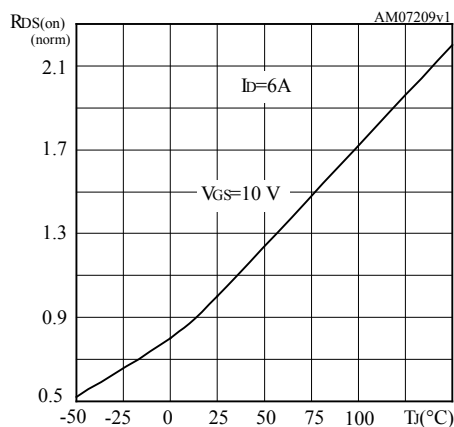


Figure 12. Normalized breakdown voltage vs temperature

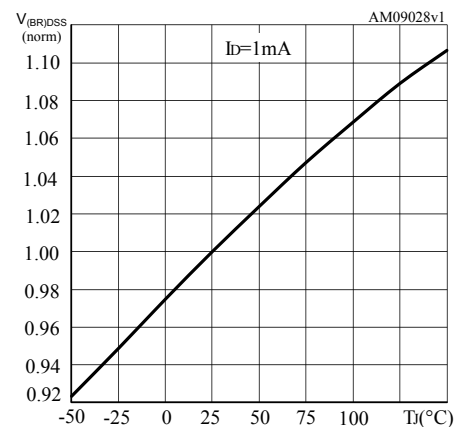
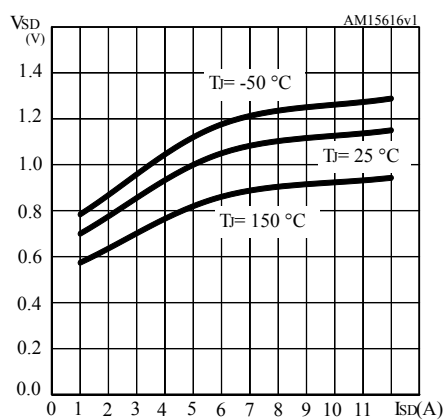
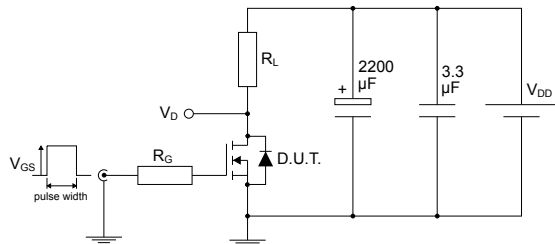


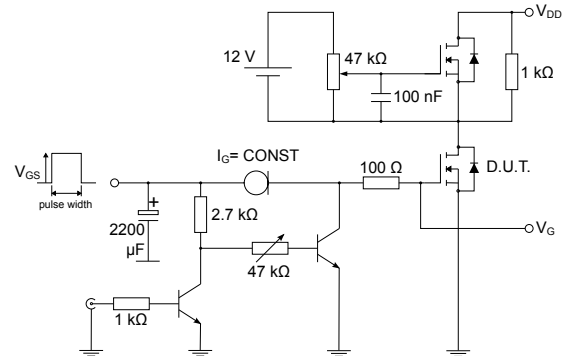
Figure 13. Typical reverse diode forward characteristics



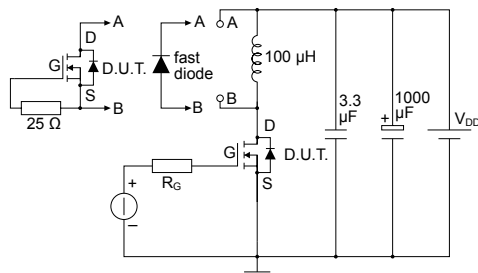
3 Test circuits

Figure 14. Test circuit for resistive load switching times


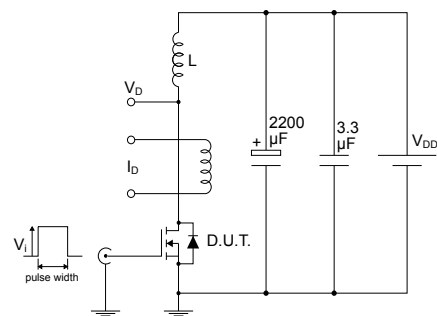
AM01468v1

Figure 15. Test circuit for gate charge behavior


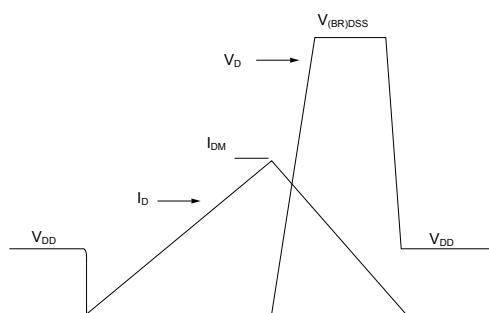
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Figure 16. Test circuit for inductive load switching and diode recovery times


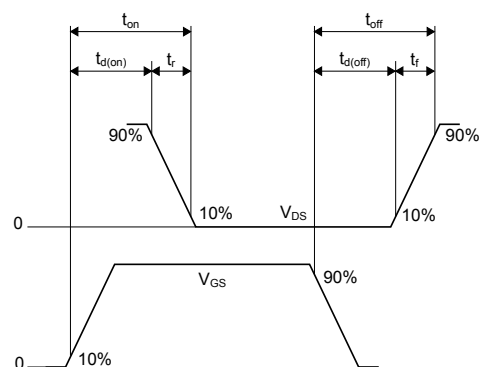
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Figure 17. Unclamped inductive load test circuit


AM01471v1

Figure 18. Unclamped inductive waveform


AM01472v1

Figure 19. Switching time waveform


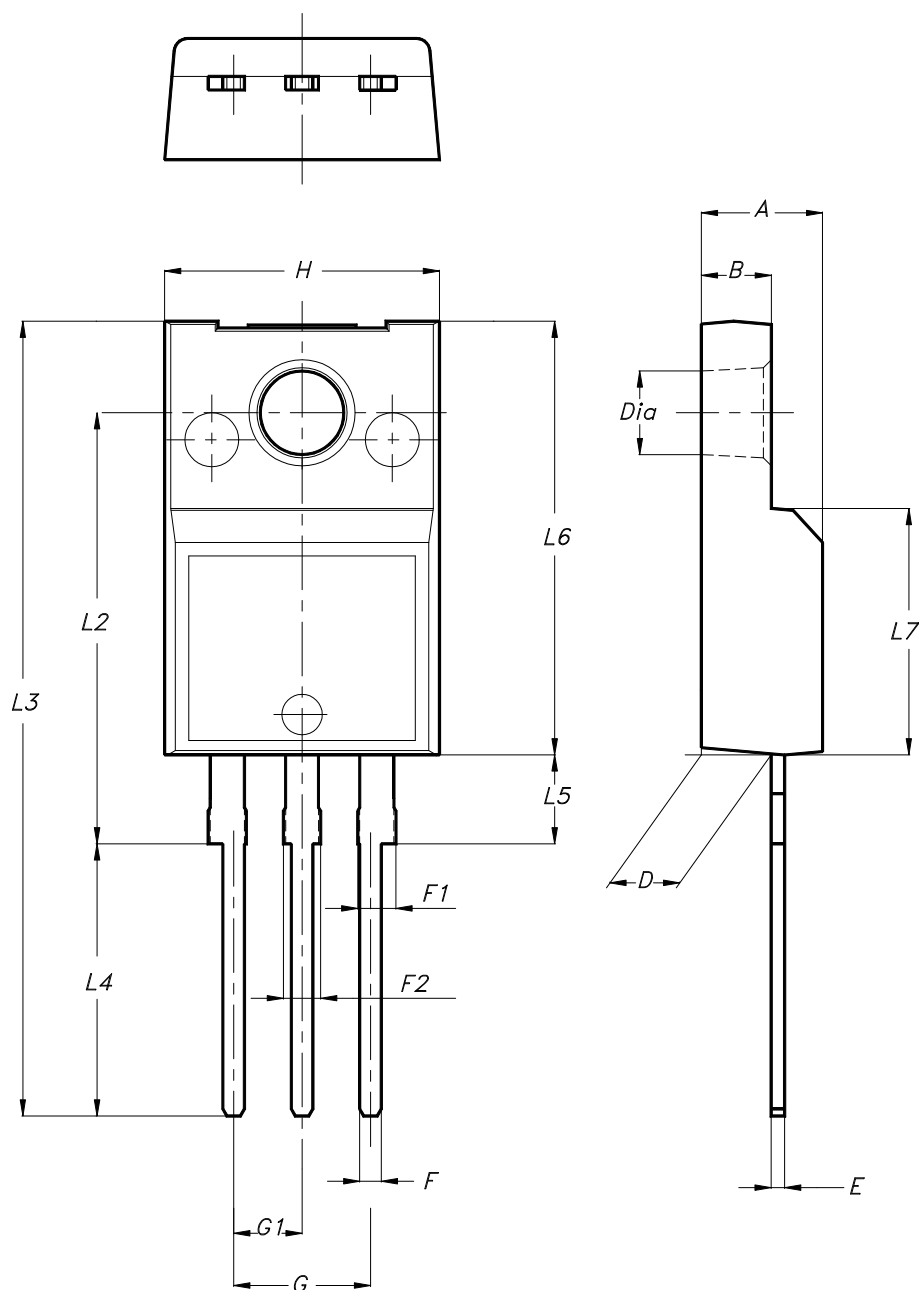
AM01473v1

4 Package information

To meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions, and product status are available at: www.st.com. ECOPACK is an ST trademark.

4.1 TO-220FP type B package information

Figure 20. TO-220FP type B package outline



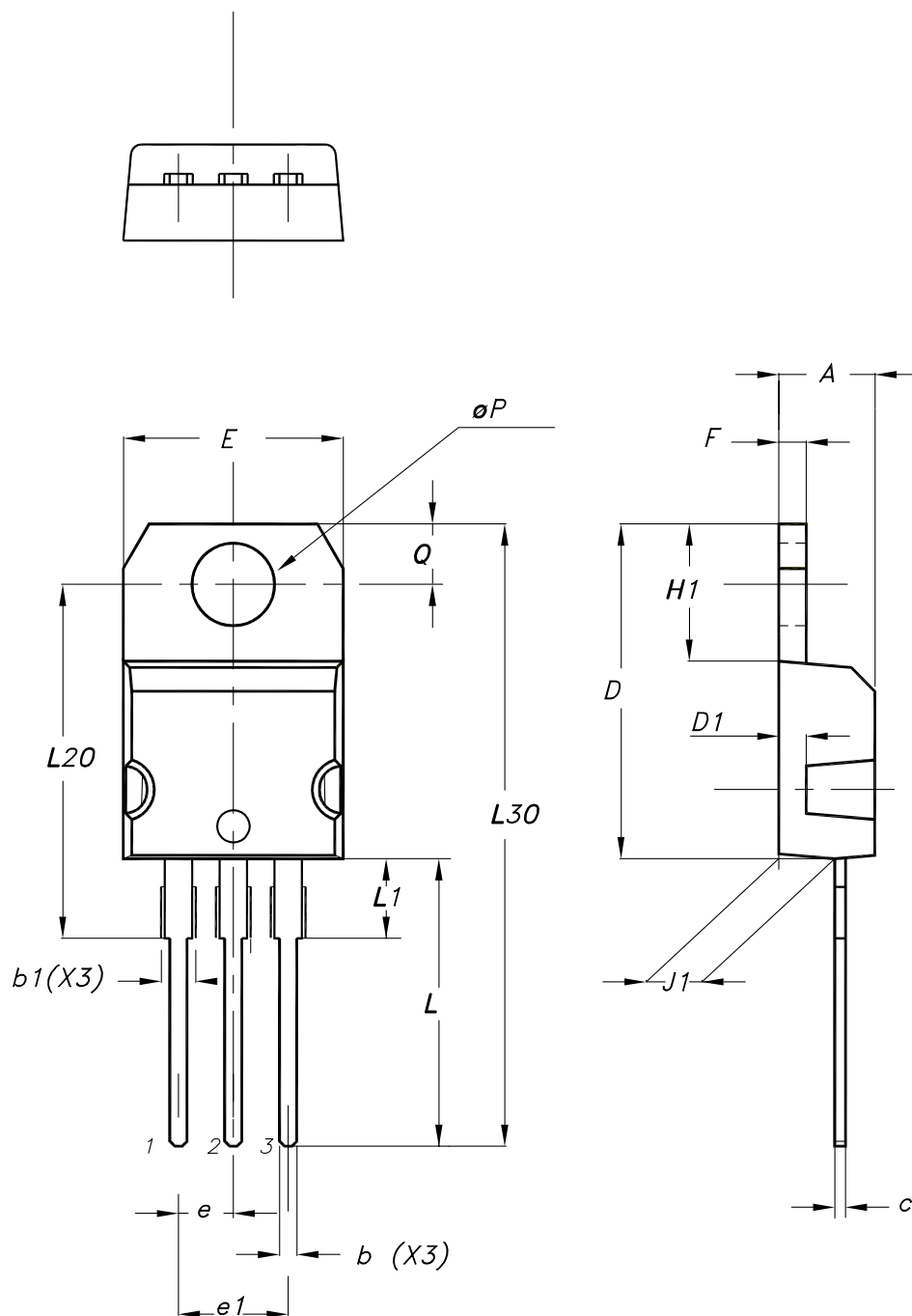
7012510_B_rev.14

Table 8. TO-220FP type B package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
B	2.50		2.70
D	2.50		2.75
E	0.45		0.70
F	0.75		1.00
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.20
G1	2.40		2.70
H	10.00		10.40
L2		16.00	
L3	28.60		30.60
L4	9.80		10.60
L5	2.90		3.60
L6	15.90		16.40
L7	9.00		9.30
Dia	3.00		3.20

4.2 TO-220 type A package information

Figure 21. TO-220 type A package outline



0015988_typeA_Rev_24

Table 9. TO-220 type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95
Slug flatness		0.03	0.10

Revision history

Table 10. Document revision history

Date	Revision	Changes
26-Nov-2009	1	Preliminary version
02-Dec-2009	2	Complete version
22-Jul-2010	3	Modified value on <i>Figure 8</i>
06-Apr-2011	4	New dv/dt value on <i>Table 5</i>
30-Oct-2012	5	The document has been reformatted
07-Feb-2013	6	Updated I_D value on <i>Table 2: Absolute maximum ratings</i>
05-Jun-2014	7	Inserted dv/dt value in <i>Table 2: Absolute maximum ratings</i>
11-Dec-2025	8	The part number STF14NM50N has been removed and the document has been updated accordingly. Updated Section 4: Package information . Minor text changes.



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